

**Specification**

- 5 Electric Circuit Board Component and Method of Automatically Providing Circuit Boards with such Components

10 The invention relates to an electric circuit board component, in particular an RF coaxial connector, in which the housing of the component is secured on the circuit board by way of solder joints between the SMD solder connections provided on the bottom side of said housing and solder connections assigned thereto on the circuit board.

15 Electric circuit board components, in particular RF coaxial connectors, are frequently employed in electric transmission and connection means. Basically, there are employed three different connection types for the electrical connection between the mutually associated terminals on the side of the component and on the side of the circuit board.

25 In the connection type - first connection type - as employed e.g. in the connector known from document EP 0 582 960 A1, there are used pressing pins, whereby a soldering operation can be dispensed with. However, the utilization of such relatively voluminous pressing pins presupposes that the number thereof per component be limited in consideration of the as small as possible dimensions of such components. However, the number thereof per component is also limited considerably in that the pressing force to be applied in urging the pressing pins on the component side into the associated plated connecting holes on the circuit board side must not exceed  
35 a value given by the strength of the component. For, the pressing force to be applied is proportional to the num-

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ber of pressing pins provided. The automatic provision  
of circuit boards with such components requires very ex-  
40 pensive devices.

In the connection type - second connection type - as em-  
ployed for example with the connector known from docu-  
ment EP 0 488 482 A1, the terminals consist of solder  
45 pins made of thin wires. Such solder pins may also be  
employed in relatively large numbers for components of  
quite small dimensions. However, such connectors upon  
mounting thereof must be applied manually to the circuit  
board, as it is difficult to introduce the thin solder  
50 pins into their associated connecting holes in the cir-  
cuit board. Upon application of such connectors on the  
circuit board, soldering of the solder pins in their as-  
sociated connecting holes in the circuit board takes  
place by flow soldering.

55 In case of the connection type - third connection type -  
as utilized e.g. for the connector known from document  
DE 197 16 139 C1, so-called SMD (surface mounted device)  
solder connections are employed for establishing the  
60 electrical connections between component and circuit  
board. The provision of the circuit boards with compo-  
nents having SMD solder connections, in contrast to  
those having pressing pins or solder pins, has the great  
advantage that it can be carried out simply and rapidly  
65 by means of automatic "pick & place" machines. The dis-  
advantage thereof is the low anchoring strength of the  
component on the circuit board established by these sol-  
dering joints. For this reason, the component must be  
additionally secured to the circuit board by means of  
70 bolts or rivets, so as to prevent damaging or even tear-  
ing off of the SMD solder joints due to occasionally un-  
avoidable higher mechanical loads.

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75 It is the object of the invention to indicate a further solution for sufficiently securing electric components having SMD solder connections to circuit boards, which does not require screws or rivets and is particularly simple in terms of production technology.

80 According to the invention, this object is met for such an electric circuit board component in that the housing, for additionally securing the same to the circuit board, has on the bottom side thereof a plurality of solderable bolt pins which engage in continuous plated bolt holes  
85 assigned thereto on the circuit board and are soldered in said bolt holes.

The invention is based on the finding that the loading of circuit boards with the aid of automatic pick & place  
90 machines is also possible if the component has solder-pin-like connecting elements which are soldered in the circuit board in associated continuous plated holes. The sole prerequisite in this regard is that their cross-sectional area is sufficiently large to allow utilization thereof as centering means by the automatic pick &  
95 place machines upon application of the component to the circuit board.

100 Expedient developments of the subject matter according to claim 1 are indicated in the additional claims 2 to 8.

A further development is indicated in claims 9 and 10 in the form of method of automatically providing circuit  
105 boards with circuit board components making use of the invention, with said method being particularly advantageous in terms of time and costs.

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FOI b6 b7C b7E b7F b7G b7H b7I b7J b7K b7L b7M b7N b7O b7P b7Q b7R b7S b7T b7U b7V b7W b7X b7Y b7Z b7AA b7AB b7AC b7AD b7AE b7AF b7AG b7AH b7AI b7AJ b7AK b7AL b7AM b7AN b7AO b7AP b7AQ b7AR b7AS b7AT b7AU b7AV b7AW b7AX b7AY b7AZ b7BA b7BB b7BC b7BD b7BE b7BF b7BG b7BH b7BI b7BJ b7BK b7BL b7BM b7BN b7BO b7BP b7BQ b7BR b7BS b7BT b7BU b7BV b7BW b7BX b7BY b7BZ b7CA b7CB b7CC b7CD b7CE b7CF b7CG b7CH b7CI b7CJ b7CK b7CL b7CM b7CN b7CO b7CP b7CQ b7CR b7CS b7CT b7CU b7CV b7CW b7CX b7CY b7CZ b7DA b7DB b7DC b7DD b7DE b7DF b7DG b7DH b7DI b7DJ b7DK b7DL b7DM b7DN b7DO b7DP b7DQ b7DR b7DS b7DT b7DU b7DV b7DW b7DX b7DY b7DZ b7EA b7EB b7EC b7ED b7EE b7EF b7EG b7EH b7EI b7EJ b7EK b7EL b7EM b7EN b7EO b7EP b7EQ b7ER b7ES b7ET b7EU b7EV b7EW b7EX b7EY b7EZ b7FA b7FB b7FC b7FD b7FE b7FF b7FG b7FH b7FI b7FJ b7FK b7FL b7FM b7FN b7FO b7FP b7FQ b7FR b7FS b7FT b7FU b7FV b7FW b7FX b7FY b7FZ b7GA b7GB b7GC b7GD b7GE b7GF b7GG b7GH b7GI b7GJ b7GK b7GL b7GM b7GN b7GO b7GP b7GQ b7GR b7GS b7GT b7GU b7GV b7GW b7GX b7GY b7GZ b7HA b7HB b7HC b7HD b7HE b7HF b7HG b7HH b7HI b7HJ b7HK b7HL b7HM b7HN b7HO b7HP b7HQ b7HR b7HS b7HT b7HU b7HV b7HW b7HX b7HY b7HZ b7IA b7IB b7IC b7ID b7IE b7IF b7IG b7IH b7II b7IJ b7IK b7IL b7IM b7IN b7IO b7IP b7IQ b7IR b7IS b7IT b7IU b7IV b7IW b7IX b7IY b7IZ b7JA b7JB b7JC b7JD b7JE b7JF b7JG b7JH b7JI b7JJ b7JK b7JL b7JM b7JN b7JO b7JP b7JQ b7JR b7JS b7JT b7JU b7JV b7JW b7JX b7JY b7JZ b7KA b7KB b7KC b7KD b7KE b7KF b7KG b7KH b7KI b7KJ b7KK b7KL b7KM b7KN b7KO b7KP b7KQ b7KR b7KS b7KT b7KU b7KV b7KW b7KX b7KY b7KZ b7LA b7LB b7LC b7LD b7LE b7LF b7LG b7LH b7LI b7LJ b7LK b7LL b7LM b7LN b7LO b7LP b7LQ b7LR b7LS b7LT b7LU b7LV b7LW b7LX b7LY b7LZ b7MA b7MB b7MC b7MD b7ME b7MF b7MG b7MH b7MI b7MJ b7MK b7ML b7MN b7MO b7MP b7MQ b7MR b7MS b7MT b7MU b7MV b7MW b7MX b7MY b7MZ b7NA b7NB b7NC b7ND b7NE b7NF b7NG b7NH b7NI b7NJ b7NK b7NL b7NM b7NO b7NP b7NQ b7NR b7NS b7NT b7NU b7NV b7NW b7NX b7NY b7NZ b7OA b7OB b7OC b7OD b7OE b7OF b7OG b7OH b7OI b7OJ b7OK b7OL b7OM b7ON b7OO b7OP b7OQ b7OR b7OS b7OT b7OU b7OV b7OW b7OX b7OY b7OZ b7PA b7PB b7PC b7PD b7PE b7PF b7PG b7PH b7PI b7PJ b7PK b7PL b7PM b7PN b7PO b7PP b7PQ b7PR b7PS b7PT b7PU b7PV b7PW b7PX b7PY b7PZ b7QA b7QB b7QC b7QD b7QE b7QF b7QG b7QH b7QI b7QJ b7QK b7QL b7QM b7QN b7QO b7QP b7QQ b7QR b7QS b7QT b7QU b7QV b7QW b7QX b7QY b7QZ b7RA b7RB b7RC b7RD b7RE b7RF b7RG b7RH b7RI b7RJ b7RK b7RL b7RM b7RN b7RO b7RP b7RQ b7RR b7RS b7RT b7RU b7RV b7RW b7RX b7RY b7RZ b7SA b7SB b7SC b7SD b7SE b7SF b7SG b7SH b7SI b7SJ b7SK b7SL b7SM b7SN b7SO b7SP b7SQ b7SR b7SS b7ST b7SU b7SV b7SW b7SX b7SY b7SZ b7TA b7TB b7TC b7TD b7TE b7TF b7TG b7TH b7TI b7TJ b7TK b7TL b7TM b7TN b7TO b7TP b7TQ b7TR b7TS b7TT b7TU b7TV b7TW b7TX b7TY b7TZ b7UA b7UB b7UC b7UD b7UE b7UF b7UG b7UH b7UI b7UJ b7UK b7UL b7UM b7UN b7UO b7UP b7UQ b7UR b7US b7UT b7UU b7UV b7UW b7UX b7UY b7UZ b7VA b7VB b7VC b7VD b7VE b7VF b7VG b7VH b7VI b7VJ b7VK b7VL b7VM b7VN b7VO b7VP b7VQ b7VR b7VS b7VT b7VU b7VV b7VW b7VX b7VY b7VZ b7WA b7WB b7WC b7WD b7WE b7WF b7WG b7WH b7WI b7WJ b7WK b7WL b7WM b7WN b7WO b7WP b7WQ b7WR b7WS b7WT b7WU b7WV b7WW b7WX b7WY b7WZ b7XA b7XB b7XC b7XD b7XE b7XF b7XG b7XH b7XI b7XJ b7XK b7XL b7XM b7XN b7XO b7XP b7XQ b7XR b7XS b7XT b7XU b7XV b7XW b7XX b7XY b7XZ b7YA b7YB b7YC b7YD b7YE b7YF b7YG b7YH b7YI b7YJ b7YK b7YL b7YM b7YN b7YO b7YP b7YQ b7YR b7YS b7YT b7YU b7YV b7YW b7YX b7YY b7YZ b7ZA b7ZB b7ZC b7ZD b7ZE b7ZF b7ZG b7ZH b7ZI b7ZJ b7ZK b7ZL b7ZM b7ZN b7ZO b7ZP b7ZQ b7ZR b7ZS b7ZT b7ZU b7ZV b7ZW b7ZX b7ZY b7ZZ b7AA b7AB b7AC b7AD b7AE b7AF b7AG b7AH b7AI b7AJ b7AK b7AL b7AM b7AN b7AO b7AP b7AQ b7AR b7AS b7AT b7AU b7AV b7AW b7AX b7AY b7AZ b7BA b7BB b7BC b7BD b7BE b7BF b7BG b7BH b7BI b7BJ b7BK b7BL b7BM b7BN b7BO b7BP b7BQ b7BR b7BS b7BT b7BU b7BV b7BW b7BX b7BY b7BZ b7CA b7CB b7CC b7CD b7CE b7CF b7CG b7CH b7CI b7CJ b7CK b7CL b7CM b7CN b7CO b7CP b7CQ b7CR b7CS b7CT b7CU b7CV b7CW b7CX b7CY b7CZ b7DA b7DB b7DC b7DD b7DE b7DF b7DG b7DH b7DI b7DJ b7DK b7DL b7DM b7DN b7DO b7DP b7DQ b7DR b7DS b7DT b7DU b7DV b7DW b7DX b7DY b7DZ b7EA b7EB b7EC b7ED b7EE b7EF b7EG b7EH b7EI b7EJ b7EK b7EL b7EM b7EN b7EO b7EP b7EQ b7ER b7ES b7ET b7EU b7EV b7EW b7EX b7EY b7EZ b7FA b7FB b7FC b7FD b7FE b7FF b7FG b7FH b7FI b7FJ b7FK b7FL b7FM b7FN b7FO b7FP b7FQ b7FR b7FS b7FT b7FU b7FV b7FW b7FX b7FY b7FZ b7GA b7GB b7GC b7GD b7GE b7GF b7GG b7GH b7GI b7GJ b7GK b7GL b7GM b7GN b7GO b7GP b7GQ b7GR b7GS b7GT b7GU b7GV b7GW b7GX b7GY b7GZ b7HA b7HB b7HC b7HD b7HE b7HF b7HG b7HH b7HI b7HJ b7HK b7HL b7HM b7HN b7HO b7HP b7HQ b7HR b7HS b7HT b7HU b7HV b7HW b7HX b7HY b7HZ b7IA b7IB b7IC b7ID b7IE b7IF b7IG b7IH b7II b7IJ b7IK b7IL b7IM b7IN b7IO b7IP b7IQ b7IR b7IS b7IT b7IU b7IV b7IW b7IX b7IY b7IZ b7JA b7JB b7JC b7JD b7JE b7JF b7JG b7JH b7JI b7JJ b7JK b7JL b7JM b7JN b7JO b7JP b7JQ b7JR b7JS b7JT b7JU b7JV b7JW b7JX b7JY b7JZ b7KA b7KB b7KC b7KD b7KE b7KF b7KG b7KH b7KI b7KJ b7KK b7KL b7KM b7KN b7KO b7KP b7KQ b7KR b7KS b7KT b7KU b7KV b7KW b7KX b7KY b7KZ b7LA b7LB b7LC b7LD b7LE b7LF b7LG b7LH b7LI b7LJ b7LK b7LL b7LM b7LN b7LO b7LP b7LQ b7LR b7LS b7LT b7LU b7LV b7LW b7LX b7LY b7LZ b7MA b7MB b7MC b7MD b7ME b7MF b7MG b7MH b7MI b7MJ b7MK b7ML b7MN b7MO b7MP b7MQ b7MR b7MS b7MT b7MU b7MV b7MW b7MX b7MY b7MZ b7NA b7NB b7NC b7ND b7NE b7NF b7NG b7NH b7NI b7NJ b7NK b7NL b7NM b7NO b7NP b7NQ b7NR b7NS b7NT b7NU b7NV b7NW b7NX b7NY b7NZ b7OA b7OB b7OC b7OD b7OE b7OF b7OG b7OH b7OI b7OJ b7OK b7OL b7OM b7ON b7OO b7OP b7OQ b7OR b7OS b7OT b7OU b7OV b7OW b7OX b7OY b7OZ b7PA b7PB b7PC b7PD b7PE b7PF b7PG b7PH b7PI b7PJ b7PK b7PL b7PM b7PN b7PO b7PP b7PQ b7PR b7PS b7PT b7PU b7PV b7PW b7PX b7PY b7PZ b7QA b7QB b7QC b7QD b7QE b7QF b7QG b7QH b7QI b7QJ b7QK b7QL b7QM b7QN b7QO b7QP b7QQ b7QR b7QS b7QT b7QU b7QV b7QW b7QX b7QY b7QZ b7RA b7RB b7RC b7RD b7RE b7RF b7RG b7RH b7RI b7RJ b7RK b7RL b7RM b7RN b7RO b7RP b7RQ b7RR b7RS b7RT b7RU b7RV b7RW b7RX b7RY b7RZ b7SA b7SB b7SC b7SD b7SE b7SF b7SG b7SH b7SI b7SJ b7SK b7SL b7SM b7SN b7SO b7SP b7SQ b7SR b7SS b7ST b7SU b7SV b7SW b7SX b7SY b7SZ b7TA b7TB b7TC b7TD b7TE b7TF b7TG b7TH b7TI b7TJ b7TK b7TL b7TM b7TN b7TO b7TP b7TQ b7TR b7TS b7TT b7TU b7TV b7TW b7TX b7TY b7TZ b7UA b7UB b7UC b7UD b7UE b7UF b7UG b7UH b7UI b7UJ b7UK b7UL b7UM b7UN b7UO b7UP b7UQ b7UR b7US b7UT b7UU b7UV b7UW b7UX b7UY b7UZ b7VA b7VB b7VC b7VD b7VE b7VF b7VG b7VH b7VI b7VJ b7VK b7VL b7VM b7VN b7VO b7VP b7VQ b7VR b7VS b7VT b7VU b7VV b7VW b7VX b7VY b7VZ b7WA b7WB b7WC b7WD b7WE b7WF b7WG b7WH b7WI b7WJ b7WK b7WL b7WM b7WN b7WO b7WP b7WQ b7WR b7WS b7WT b7WU b7WV b7WW b7WX b7WY b7WZ b7XA b7XB b7XC b7XD b7XE b7XF b7XG b7XH b7XI b7XJ b7XK b7XL b7XM b7XN b7XO b7XP b7XQ b7XR b7XS b7XT b7XU b7XV b7XW b7XX b7XY b7XZ b7YA b7YB b7YC b7YD b7YE b7YF b7YG b7YH b7YI b7YJ b7YK b7YL b7YM b7YN b7YO b7YP b7YQ b7YR b7YS b7YT b7YU b7YV b7YW b7YX b7YY b7YZ b7ZA b7ZB b7ZC b7ZD b7ZE b7ZF b7ZG b7ZH b7ZI b7ZJ b7ZK b7ZL b7ZM b7ZN b7ZO b7ZP b7ZQ b7ZR b7ZS b7ZT b7ZU b7ZV b7ZW b7ZX b7ZY b7ZZ

110 The invention will be elucidated in more detail herein-  
after by way of an embodiment shown in the drawings  
wherein

Fig. 1 shows a perspective view of an embodiment in the  
form of an RF angular connector,

115 Fig. 2 shows a schematic view of the anchoring of bolt  
pins on the housing in bolt holes in the circuit  
board according to a first embodiment,

120 Fig. 3 shows a schematic view of the anchoring of bolt  
pins on the housing in bolt holes in the circuit  
board according to a second embodiment.

125 The first embodiment of an electric circuit board compo-  
nent illustrated in Fig. 1 is an RF angular connector.  
The basic structure thereof corresponds to the connector  
already known from the initially indicated document DE  
197 16 139 C1. For this reason, it should be sufficient  
130 to deal with the structure of the constructional shape  
of this first embodiment only in so far as it is neces-  
sary for the understanding of the invention and, as for  
the rest, to make reference to the document mentioned as  
regards closer details thereof.

Sub 017 135 The housing 1, which may also be a metal housing, in the  
instant case consists of metallized plastics material.  
On the mating plug side 2 thereof, it has four coaxial  
sockets 3 in a row an column arrangement. The layer  
thickness of the metallization of housing 1 is at least  
140 equal to the depth of penetration of the electromagnetic  
waves to be transmitted via the circuit board component.

Housing 1 has contacting feet 4 and 5, of which contact-  
ing feet 4 are arranged in a multiplicity on the outside  
145 of housing 1 near the bottom side 6 thereof. Contacting

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feet 4 have abutting areas designed as tinnable SMD solder terminals. Contacting feet 5 also are SMD solder terminals and consist of the ends of the metallic inner conductors exiting from the bottom side 6 and bent parallel to the latter. The contacting feet 4 and 5 serve for electrical connection of their SMD solder terminals to the associated solder terminals on circuit board 7 shown only schematically in Fig. 1 in broken lines.

The contacting feet 4 are provided in larger numbers on the outside of the side walls 8 and 9 and the back wall 10 of housing 1 and each have a comb-like structure. They have a shape of the kind of supporting webs and each slightly project with their SMD terminals beyond the bottom side 6 of housing 1. The same applies analogously to the contacting feet 5 of the inner conductor ends. Additional contacting feet 4 are provided at the edge of bottom side 6 on the mating plug side 2.

The arrangement of the contacting feet 4 and 5 on the outside of side walls 8 and 9 and back wall 10 as well as along the edge on bottom side 6 on the mating plug side 2 is important for soldering the SMD solder terminals or connections thereof to circuit board 7, since the circulating heat used in soldering can thus be fed well to the SMD solder terminals. In addition thereto, it is easily possible afterwards to inspect whether the solder joints are perfect. To ensure perfect solder joints for all SMD solder terminals upon connection of housing 1 to circuit board 7, it is advisable to provide for a planarity tolerance of  $< 0.1$  mm between all SMD terminals of the contacting feet 4 and 5.

The number of the entirety of contacting feet 4 provided, the SMD solder connections of which are electrically connected to the metallization of housing 1, is selected to be as large as possible in order to ensure

as good as possible fixing of housing 1 on circuit board 7 after the SMD solder joints have been established. As shown in practical application, the fixing of the housing attainable by SMD solder joints, however, is poor also with a larger number of SMD solder joints, so that the mechanical load capacity to be demanded for such fixing cannot be ensured to a sufficient extent.

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For sufficient mechanical securing of housing 1 on circuit board 7, there are provided several solderable bolt pins 11, as shown in Fig. 1, between contacting feet 4 as well as on the outsides of side walls 8 and 9 and back wall 10 and on the edge of bottom side 6 on the mating plug side 2; these bolt pins 11 project beyond contacting feet 4 and 5 and, upon application to circuit board 7, engage in associated contact-establishing or plated bolt holes 12 in circuit board 7 in which they are soldered. Like housing 1, the bolt pins 11 consist of plastics material. Like the contacting feet 4, they are formed on the housing walls in the manner of supporting webs and are metallized.

Soldering of the bolt pins 11 of the housing in the plated bolt holes 12 in the circuit board, as in case of soldering solder pins, can be effected by flow soldering in which circuit board 7 is passed with the bottom side 14 thereof across a flow soldering bath, with the housing 1 being arranged on the top side 13 of said circuit board. Thus, in this case it is necessary to carry out two soldering operations when circuit board 7 is provided with a housing 1.

A first soldering operation is necessary for establishing the electrical connections between the SMD solder terminals of contacting feet 4 and 5 of the housing and the solder terminals assigned thereto on circuit board 7. In this process, circuit board 7 having housing 1 ar-

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220 ranged thereon is passed through an SMD soldering furnace. Thereafter, a second soldering operation has to be carried out using a flow soldering bath for soldering the bolt pins 11 of the housing to their associated plated bolt holes 12 in the circuit board. However, soldering of the bolt pins 11 on the housing in the associated plated bolt holes 12 in the circuit board may also be carried out in particularly advantageous manner in accordance with the SMD soldering method, so that only one soldering operation has to be carried out in securing a housing 1 to circuit board 7. This fact shall be dealt with in more detail hereinafter with reference to Figs. 2 and 3.

235 Figs. 2 and 3 schematically illustrate the course of the SMD soldering operation. Each of Figs. 2 and 3 shows a housing 1 arranged on circuit board 7. Each of the housings 1 is shown with two bolt pins 11 only, one thereof being integrally formed on the left-hand side wall 8 and the other one thereof being integrally formed on the right-hand side wall 9. Both bolt pins 11 engage in their associated bolt holes 12 in circuit board 7. The central vertical subdivision of housing 1 and circuit board 7 into left-hand and right-hand halves is supposed to indicate the SMD soldering operation. The plated bolt hole 12 in the circuit board, along with the bolt pin 11 of the housing engaging therein, in the left-hand half illustrates the condition prior to passage of the circuit board 7 along with the housing 1 arranged thereon through the SMD soldering furnace, whereas the right-hand half illustrates the condition after passage thereof through the SMD soldering furnace.

255 Before application of housing 1 to circuit board 7, all soldering connections or areas on the top side 13 of circuit board 7 must be provided with a soldering paste layer. To this end, a soldering paste mask is employed.

In the region of the bolt holes 12, soldering paste 15 is applied across the same. Upon passage through the SMD soldering furnace, the soldering paste has flown into  
260 the cavity between bolt pin 11 and the plated wall of bolt hole 12, as can be seen well in the right-hand half of Figs. 2 and 3 each, whereby bolt pin 11 is firmly soldered in the bolt hole.

265 The difference between Figs. 2 and 3 resides merely in the shape of the bolt holes 12. While the plated inner wall 15 of bolt holes 12 in Fig. 2 is of vertical design, the plated inner wall 17 of bolt holes 12 in Fig. 3 is of slightly conical design. This design may make  
270 sense occasionally to prevent that the liquified soldering paste 15, upon passage of the circuit board 7 through the SMD soldering furnace, partly drips down from the bottom side 14 of circuit board 7. However, with a vertical inner wall 16, this can be prevented in  
275 general by way of a suitable, mutually matched dimensioning of bolt pin and bolt hole diameter, even if bolt pins 11 are slightly conically tapering towards the free end thereof. In the embodiment depicted in the drawings, the dimensions provided for, with a thickness S of the  
280 circuit board 7 of 1.6 mm, were as follows:

bolt hole diameter D = 2.3 mm  
bolt pin diameter d = 1.8 mm  
bolt pin length L = 2.2 mm

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